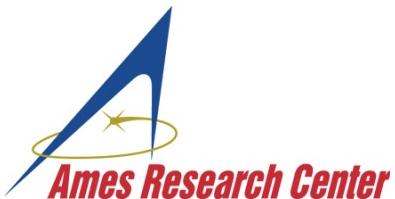


# The Development of Human Factor Guidelines for Unmanned Aircraft System Control Stations



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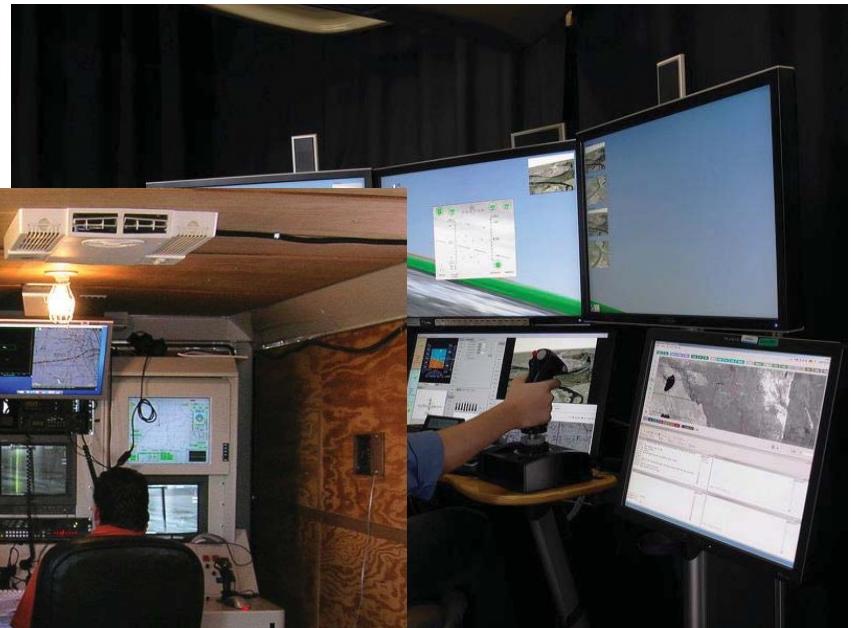
# Control Stations



# Control Stations

- Inadequate feedback to crew on system state
- Multi-mode controls
- Difficult to read fonts and colors
- Placement of critical controls next to non-critical controls
- Unreachable controls
- Reliance on text displays
- Display proliferation



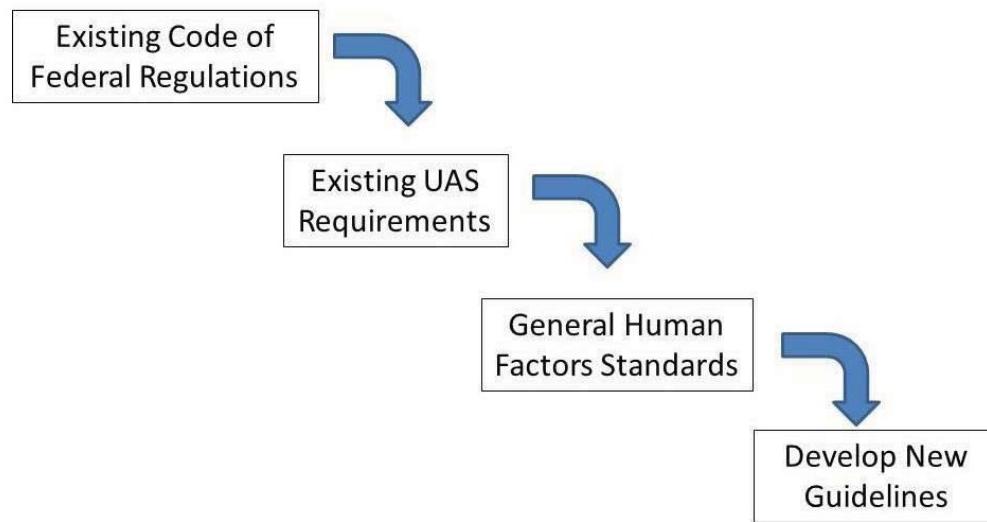


# Human Factor Design Guidelines

A statement describing a characteristic of the engineered system with the intention of promoting safe and effective human use.

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A statement describing a characteristic of the engineered system with the intention of promoting safe and effective human use.



# Examples of Existing Guidelines

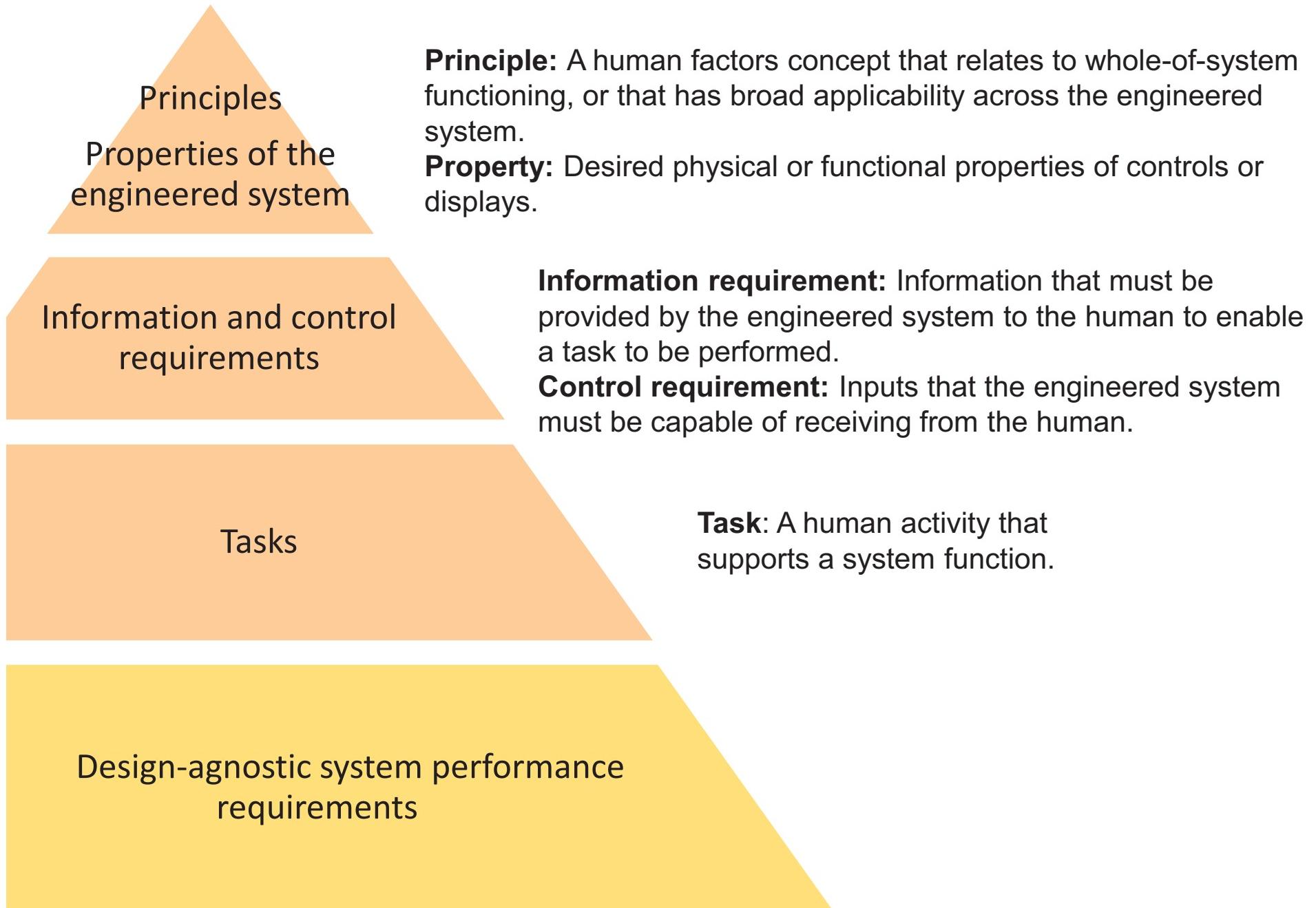
- Unmanned Aircraft Systems
  - Draft NATO UAV Standardization Agreements
  - Draft Access 5 Guidelines
  - Draft CASA Design Standards for UAVs
  - US DoD UAS GCS Human Machine Interface Guide
- Conventional Cockpits
  - FAA & EASA regulations
  - FAA Human Factor Design Guidelines for Multifunction Displays
  - RTCA, SAE, ASTM, GAMA
- General Human Factors
  - MIL STD 1472 Human Engineering
  - ANSI/HFES Human Factors Engineering of Computer Workstations
  - ISO 9241 Ergonomic Requirements for Office Work with Visual Display Terminals
  - ISO 110641 Ergonomic Design of Control Centers

# Guidelines for Guidelines

<b>Consistent</b>	As well as being internally consistent, guidelines should not conflict with regulations and other mandatory requirements.
<b>Achievable</b>	Achieving the intent of the guideline should be within current technical capabilities.
<b>Assessable</b>	It should be possible to evaluate whether the intent of a particular guideline has been met.
<b>Evidence-based</b>	Guidelines should address areas of need identified from operational experience, simulations or analysis.
<b>Organized</b>	Guidelines should be organized hierarchically, with general statements preceding specific statements.
<b>Not overly prescriptive</b>	Overly prescriptive statements should be avoided as they may constrain innovation.
<b>Not premature</b>	In the case of immature or evolving technologies, guidelines should be developed with the awareness that prematurely developed guidelines may not reflect the characteristics of the technology once it matures
<b>Applicable to diverse systems</b>	Guidelines should address a wide range of technological solutions and capabilities. Some guidelines will have general applicability, while others will address issues unique to particular technologies.

# Possible Topic Areas

- Displays
  - Replacements for lost sensory cues?
  - Signal strength, latency, approach to limit of signal
  - Other radio frequency users?
  - Status of ground station
  - Out-the-window view?
  - Obstruction of displays (by screen savers, pop-up windows)
- Controls
  - Number of mouse click or menu steps
  - Acceptable time to respond
  - Potential for wrong response
- Decision support & planning
  - Awareness of logic of automation
  - System behavior in event of lost link or system failure
  - Weather and traffic avoidance
  - Flight termination decision making
  - Control handover



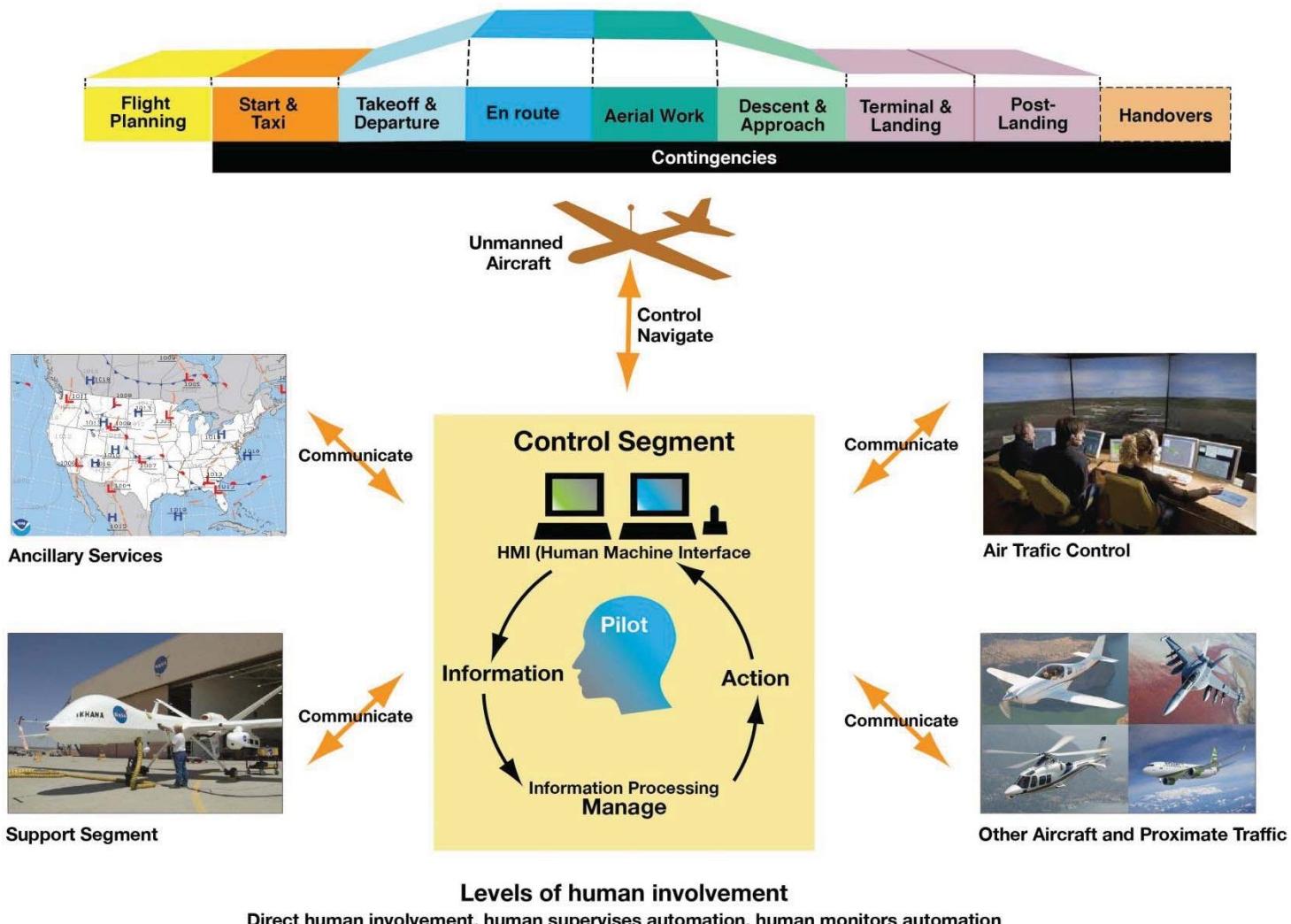
# Assumptions

- Each UAS will have a pilot in command
- Pilot can assume control at all times during normal operations
- Operations will not be autonomous during normal operations

# Out of Scope

- Control of multiple aircraft
- Line-of-sight operations
- Payload
- Procedures
- Personnel qualifications
- Training
- Security

# The Role of the UAS Pilot



5. What broad or additional principles apply across the engineered system?



Design Principles

4. How should controls and displays look, feel & sound? How should they operate?



Properties of the engineered system

3. What control capabilities must the engineered system provide the human?



Control requirements

2. What information must the engineered system provide to the human?

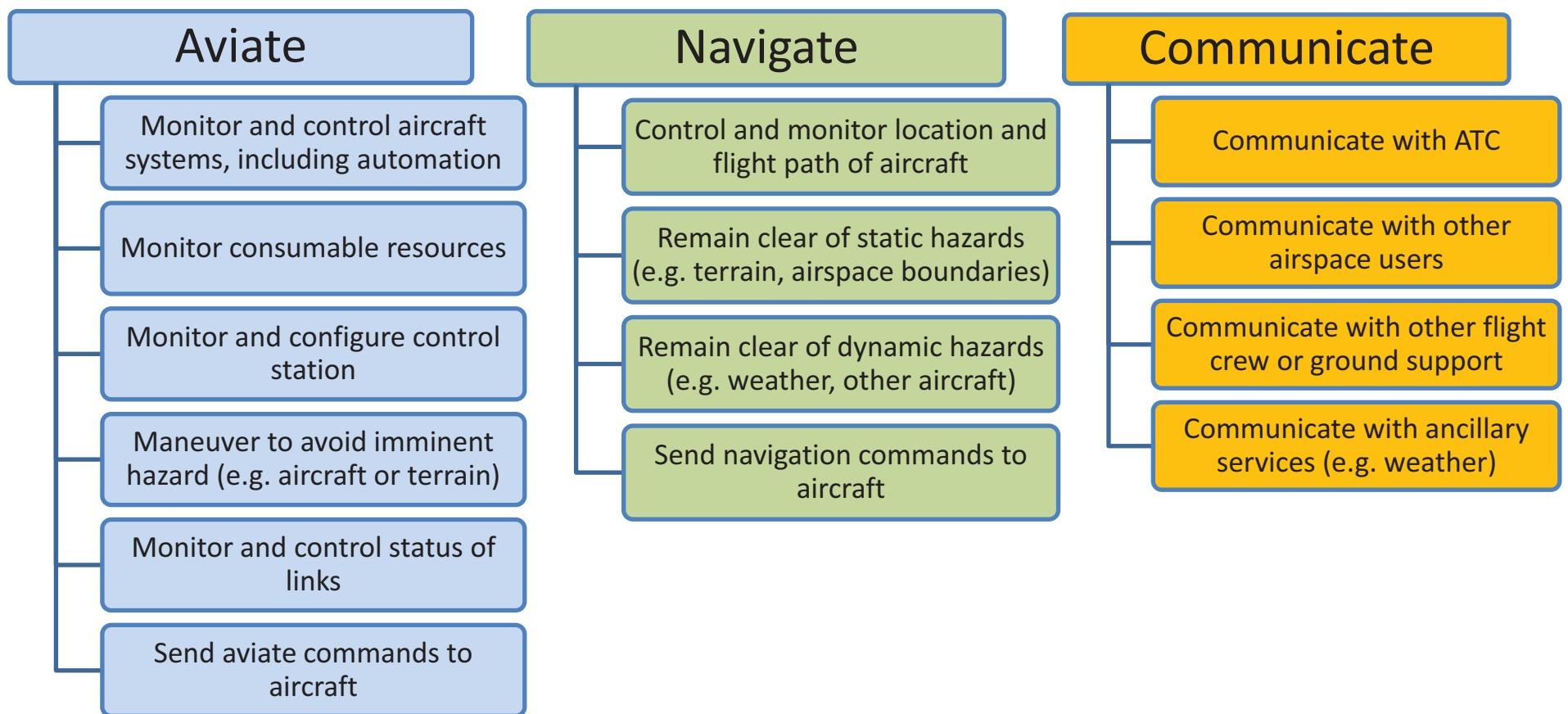
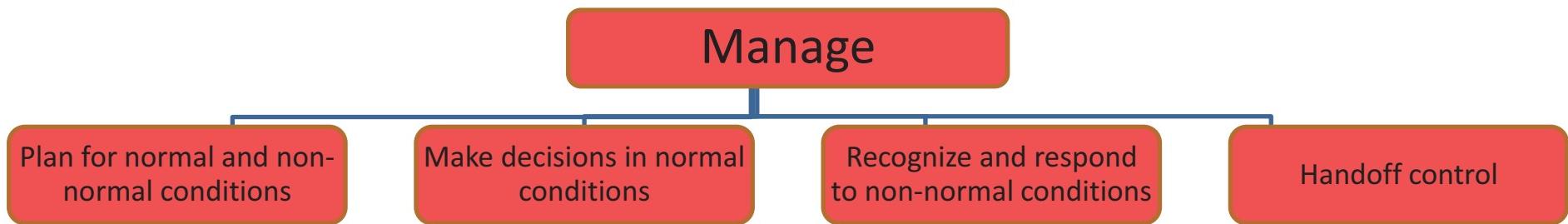


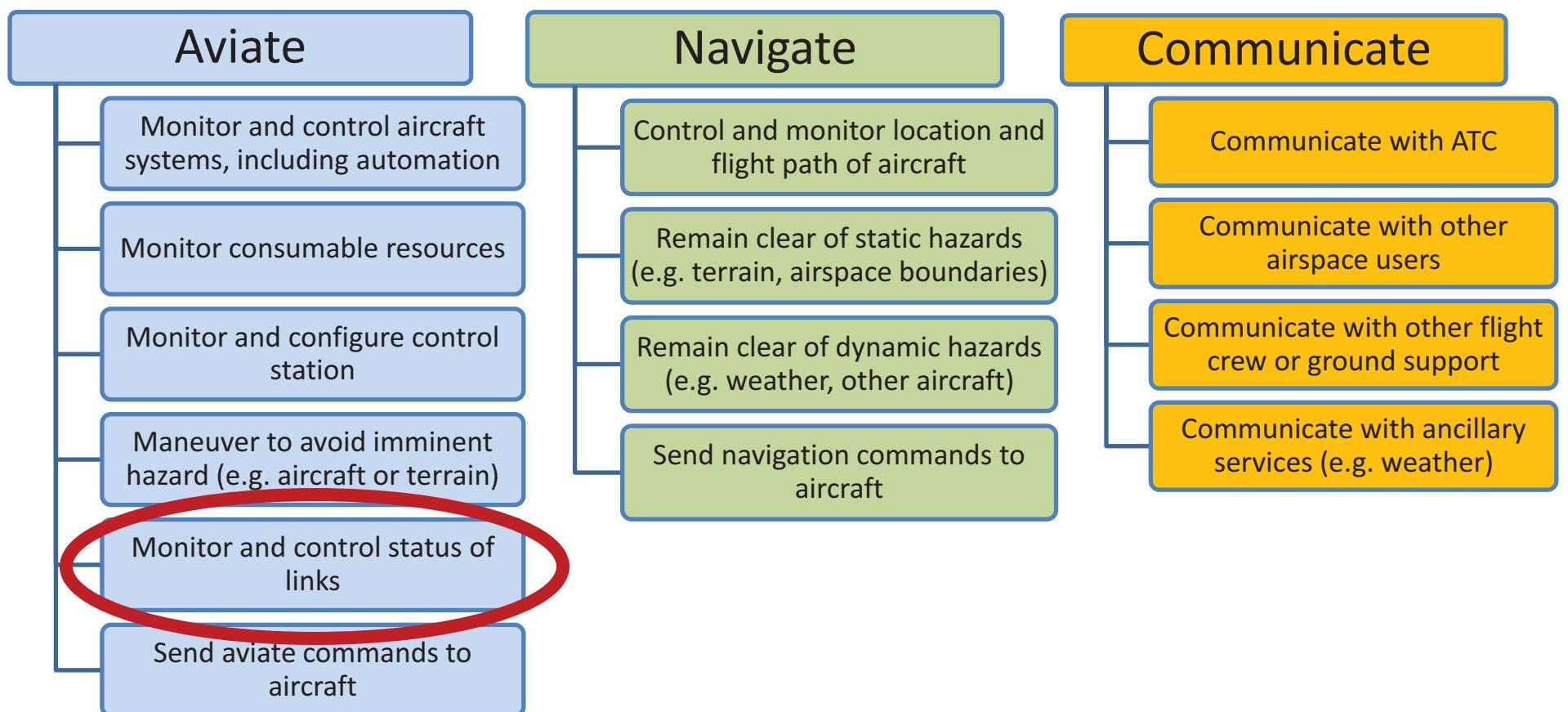
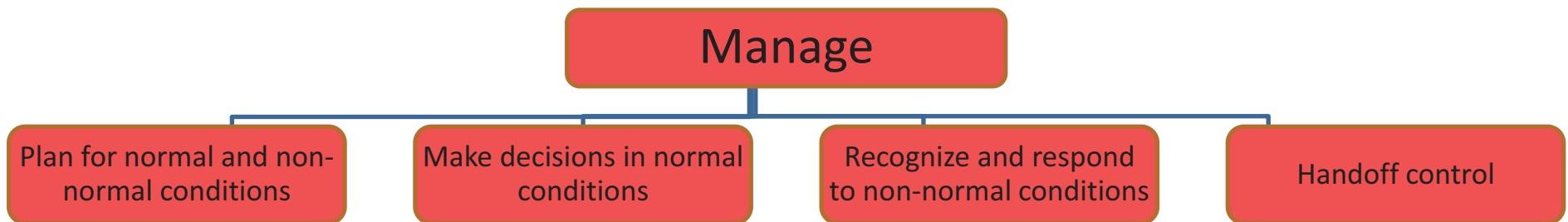
Information requirements

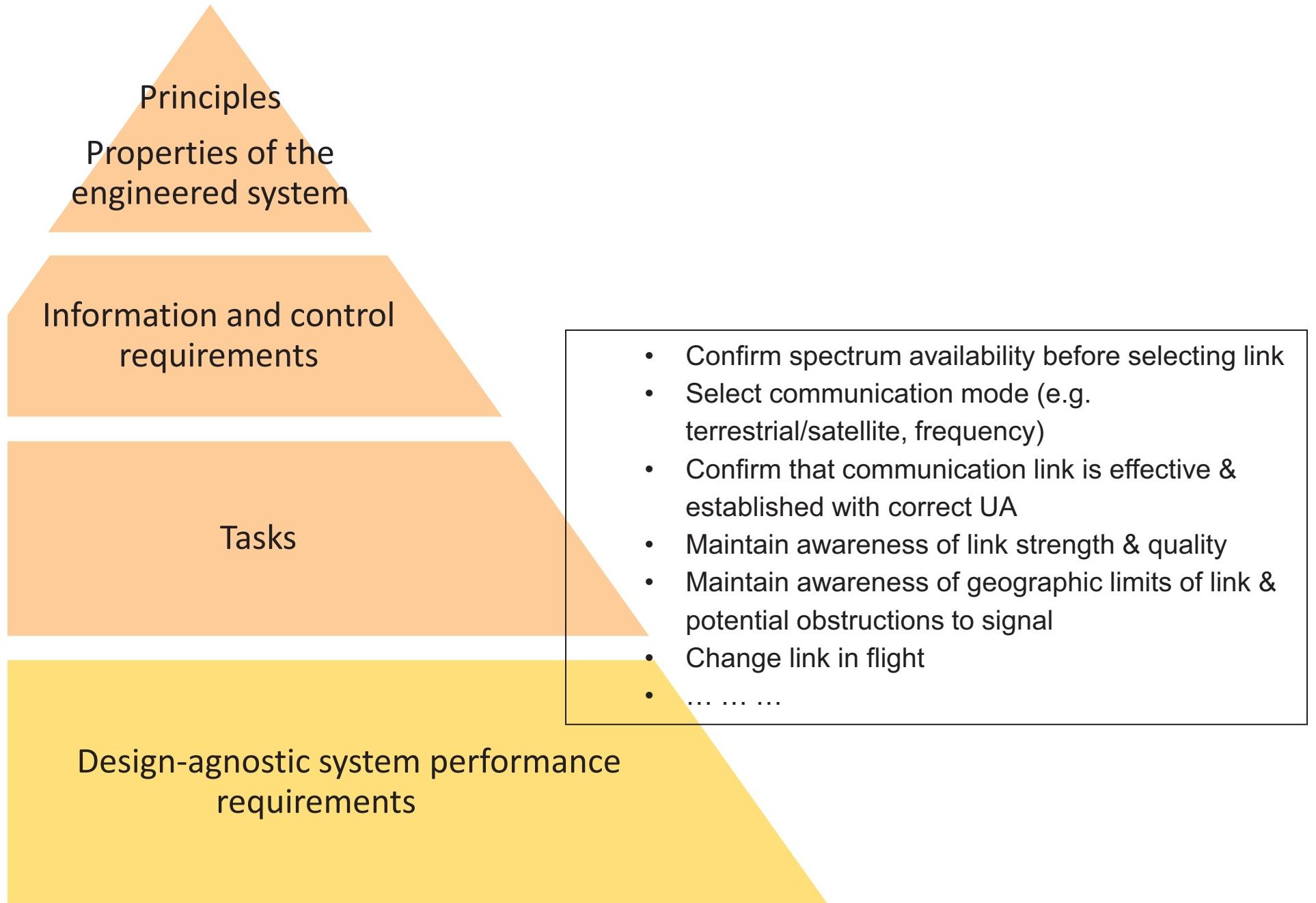
1. What tasks are expected to be performed by people?

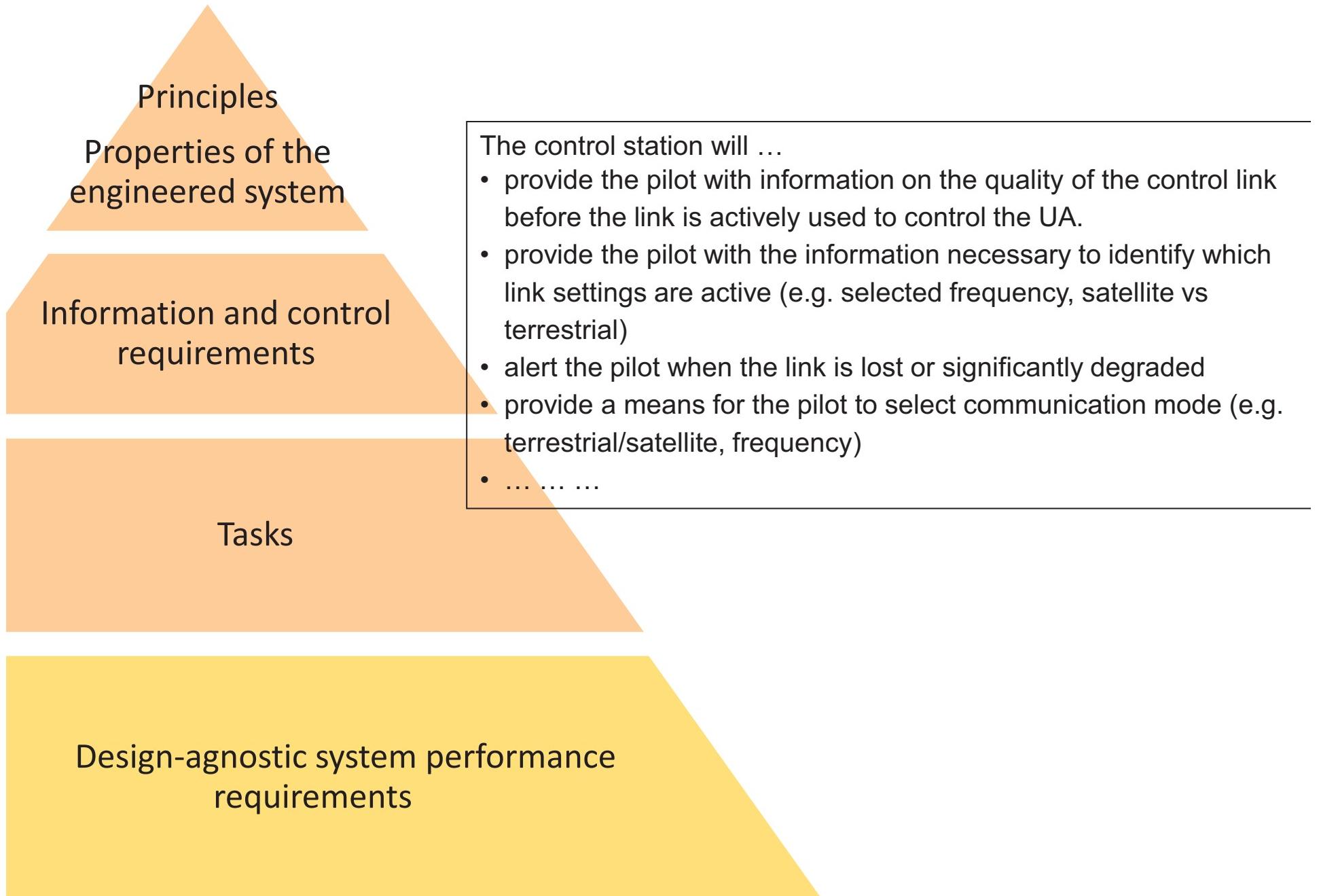


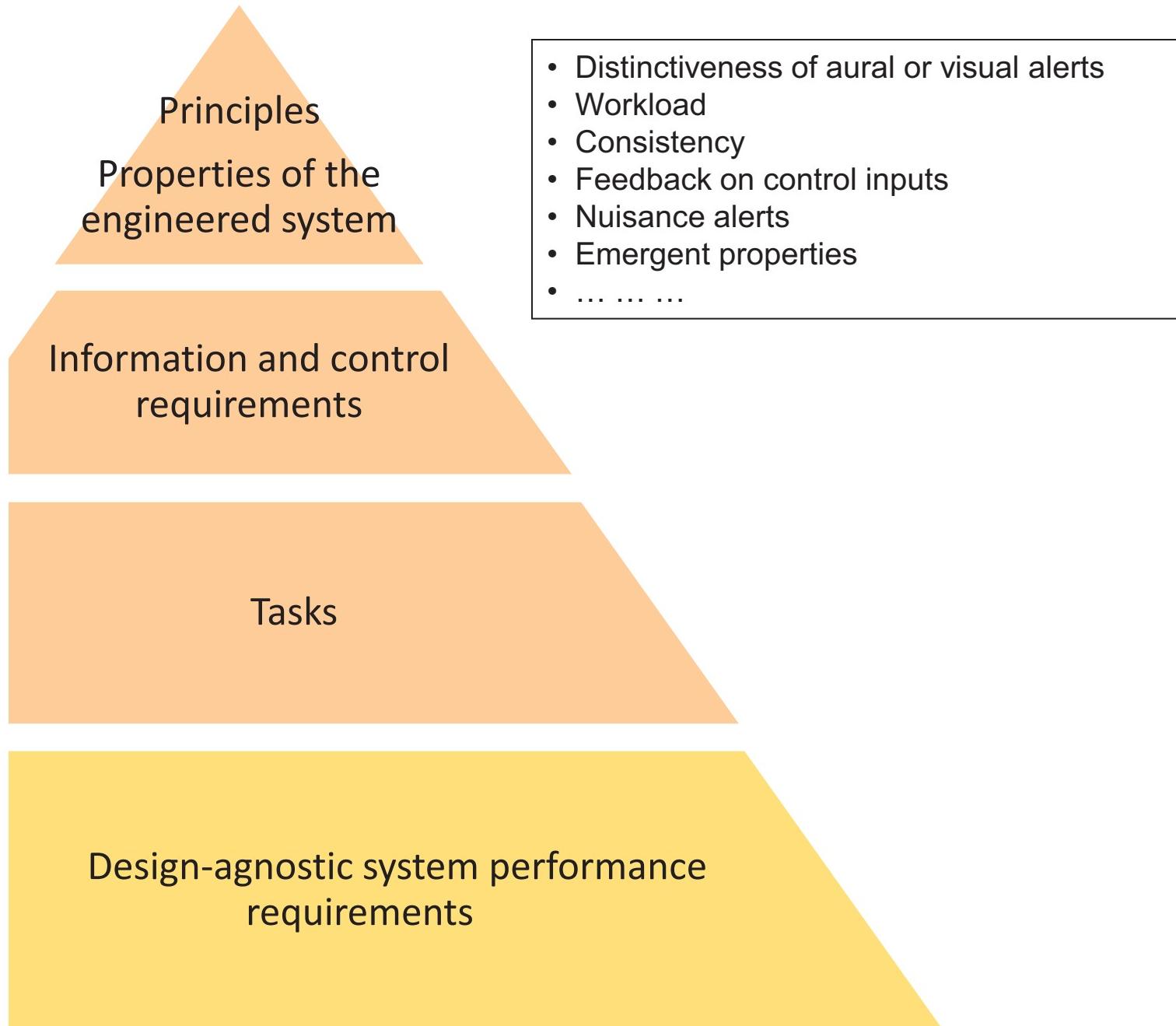
Human Tasks











# Human factors engineering process

## HFE processes

- Test and evaluation
- Task analysis
- Human failure modes and effects analysis
- Human factors probabilistic risk assessment
- Operational experience review and lessons learned
- ...
- .

*“Human errors occurring in the performance of critical tasks during test and evaluation should be analyzed to determine the reason for their occurrence”. (Department of Defense, 1999)*

# Conclusions

- Has been a failure to apply existing standards + lack of UAS-specific guidelines
- We can not wait for operational events to identify where UAS-specific guidelines are needed
- Guidelines will need to be regularly updated as experience accumulates

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